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HIGH H_2O CONTENTS OF GLASSES AND MELT INCLUSIONS FROM LOIHI SEAMOUNT: EVIDENCE FOR ASSIMILATION OF A MODIFIED SEA WATER COMPONENT.

Adam J.R. Kent[1,2], Marc D. Norman[3], Ian D. Hutcheon[4], Edward M. Stolper[1]. [1]Division of Geological and Planetary Sciences, Mail Stop 170-25, Pasadena CA, 91125, adam@expet.gps.caltech.edu; [2]IGPP, Lawrence Livermore National Laboratory, Livermore CA, 94551, [3]GEMOC, School of Earth Sciences, Macquarie University, North Ryde, NSW 2109, Australia; [4]Isotope Sciences Division, Lawrence Livermore National Laboratory, Livermore, CA, 94551.

Melt inclusions and submarine glasses are frequently analyzed for H_2O and CO_2 contents in an effort to characterize preeruptive volatile contents of magmas. It is usually assumed that volatile contents have been influenced primarily by processes such as crystal fractionation or degassing (and thus, for basaltic magmas, can be used to set limits on the volatile contents of primitive magmas); however, care must be taken to rule out the influence of assimilation of volatile-rich material. This can be an important process: e.g., incorporation of a modified sea water component is thought to have significantly altered the H_2O and Cl compositions of some MORB [1]. Here we report a case of preeruptive incorporation of a volatile-rich component, probably derived from modified sea water, into Hawaiian magma.

We have analyzed two samples from Loihi seamount, Hawaii, using SIMS (H, Li, Be, B), FTIR (H_2O, OH^-, CO_2), and the electron microprobe (major and minor elements, including Cl and S). Both samples consist primarily of glass plus olivine phenocrysts with glass inclusions. Host glasses from both samples have similar major element compositions with average MgO and K_2O contents of 8.90 and 0.55 wt.%. Melt inclusions have compositions indicating that they represent relatively unevolved melt samples (MgO contents of 9.4-12.6 wt.%). This is also suggested by the forsterite-rich nature of the olivine phenocrysts which host the melt inclusions (Fo 85.9-88.3). H_2O contents of the host glasses, based on FTIR measurements, are 1.70 ± 0.21 and 1.78 ± 0.12 wt.%. H_2O contents in glass inclusions in olivine phenocrysts, measured by SIMS, are 0.68-1.67 wt.%.

H_2O concentrations in host glasses and some melt inclusions are high compared to other samples from Loihi seamount (Fig. 1). H_2O contents in glasses and melt inclusions also loosely correlate with Cl and B (Fig. 1), and H_2O, B, and Cl contents of melt inclusions all decrease with increasing forsterite content of the host olivines. However, H_2O contents do not correlate with the concentrations of elements such as K and P that have partition coefficients comparable to that of H_2O during mantle melting. Furthermore, glass and melt inclusion compositions are not highly alkalic (maximum K_2O 0.72 wt.%). These observations strongly suggest that the high H_2O, Cl, and B contents result neither from concentration in residual liquids as a result of crystallization nor from significantly lower degrees of melting.

The elevated H_2O contents of these samples probably reflect addition of a H_2O- (and B+Cl-) bearing component within the magma chamber environments in which the olivine phenocrysts grew and trapped melt inclusions, and from which the melts now quenched to the host glasses were erupted. The MgO-rich nature of the host olivines implies that this occurred during the early stages of magma evolution, but the observed increase in the H_2O contents of melt inclusions with decreasing Fo content of the enclosing olivine (and the fact that the host glass has the highest water content) suggests that incorporation of this component was not limited to the early stages of the history of the magma chamber. Based on the trend shown in Fig. 1, the H_2O/B ratio of the H_2O-rich component is ~5000, substantially less than that of sea water (~175,000). High temperature brines and/or sea water-altered basaltic material from within the volcanic edifice are possible candidates for the assimilated component. Assimilation of sea water or sea water altered basalt has been suggested previously to account for B and H isotope systematics of some Hawaiian basalts [2, 3].

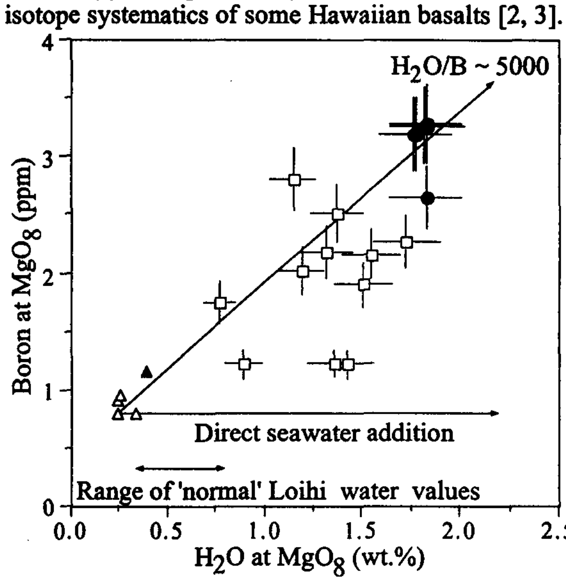

Fig. 1. B versus H_2O for Loihi samples Lo-02-02 and Lo 02-04 (● host glass, □ melt inclusions). Also shown are samples from the Kileaua East Rift Zone (△) and Loihi (▲) from [2]. Error bars show 1σ errors

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